10/018302
JC05 Rec'd PCT/PTO 29 OCT 2001

WO 00/66363 S/PRTS PCT/BE00/00044

Process for inking a printing plate with thermoplastic inks and ink tanks to be used therein

This invention relates to a process for inking a printing plate attached to a holder, with a thermoplastic ink, to be used in pad printing, wherein a relative movement is maintained between the holder and an ink tank filled with thermoplastic ink.

For the printing of substrates such as glass, ceramics and china, mostly a so-called thermoplastic ink is used. Such an ink has the viscosity of a thick paste at room temperature. For printing, this ink is heated to about 80°C, whereby it becomes very fluid. After printing, the very fluid ink on the printed substrate cools down to room temperature and consequently coagulates again. The print on the substrate is fixed by baking the printed product for a certain time at high temperature (around 800°C). By doing so, the ink vitrifies and fuses to the substrate. The result is a strongly adhesive print that does not fade or wear off, even when frequently cleaned in the dishwasher.

Silkscreen printing is at present the current process used for printing glass with thermoplastic inks to obtain an acceptable quality.

In the existing silksceen technique, a screen is used that is comprised of a plastic material or metal, but must resist to a temperature of maximum 100°C, and that is attached to a wooden or metallic frame. The screen is covered with an impermeable layer, except in the spots where ink must be able to pass the screen to form the image to be printed on the substrate.

The pasty thermoplastic inks are placed on the screen. The screen is heated, so that the thermoplastic ink becomes fluid.

By means of a doctor blade of plastic material or metal, the thermoplastic ink is pushed through the screen, only through the openings that show the image directly on the product: glass, ceramics or china. This method has the following limitations:

- limited in resolution by the use of a screen, of which the density of the threads forming the screen is physically limited;
- can only be used for printing flat and cylindrical objects;
- quality is sharply reduced as soon as the surface of the object to be printed is bent inside or outside.

Apart from silkscreen printing, also the technique known as pad printing may be used.

Pad printing with thermoplastic ink has known little succes up to now, because of lack of reliability and lack of constant quality.

In the technique which is known as "pad printing", an engraved printing plate is used, which in a first stage is inked over its entire surface, whereupon with a doctor blade the excess ink is scraped off, and collected in an ink duct or the like. The ink thus exclusively remains in the engraved parts.

The different operations involved in this, may be summarized as follows:

1) The doctor blade holder with slab is removed from the printing plate and is kept at a distance from the printing plate during the inking stage.

2) The doctor blade holder with slab is moved with respect to the printing plate during the inking stage, in the longitudinal direction thereof.

3) After the inking stage, the doctor blade is brought into contact with the printing plate.

4) The doctor blade is moved with respect to the printing plate; the ink is scraped off, except in the engraved portions, and is collected in an ink tank.

It is clear that the relative movements of the doctor blade holder with slab, with respect to the printing plate, are the result from both a moving of these parts with respect to a stationary printing plate, and the reverse, and that consequently both the printing plate and the doctor blade and the slab can be moved in opposite sense.

The doctor blade is always adjusted in such a way with respect to the printing plate, that it forms a sharp angle with this plate, with the portion of the printing plate that has been inked and must yet be scraped off.

The techniques which are generally applied and briefly described, show a series of disadvantages which can be summarized as follows:

a) The printing plate is subjected to high wear, because of the pressure exerted by the doctor blade on the printing plate. A good scraping off of the ink is indeed an absolute requirement, and this requires, at the installation of the doctor blade as described above, a high pressure of the doctor blade on the printing plate.

b) Each time, two movements are required, which can be summarized as follows: up or down movement of the doctor blade knife during the relative movements of the doctor blade with respect to the printing plate.

Since thermoplastic inks are used, which must be held at a constant, controlled temperature, many disadvantages are associated to this system. These are summarized hereafter:

- severe wear of the printing plate and doctor blade knife because of the required high pressure of the doctor blade knife on the printing plate, which strongly affects the print quality in a negative way.

- problems to keep the temperature at a constant level during the up and down movements of the doctor blade knife, which is continuously heated and cooled, as a result of which the doctor blade knife is rapidly "polluted" by hardened ink.

The combination of above disadvantages is the reason why a production with a constant print quality is almost impossibly feasible.

PATENT ABSTRACTS OF JAPAN vol. 15, no. 491 (M-1190), 12 December 1991 (1991-12-12) & JP 03 213341 A (THINK LAB KK), 18 September 1991 (1991-09-18) discloses a process for inking an etched printing cylinder with an ink which reduces viscosity by heating, whereby a relative movement is maintained between the etched surface and an ink tank filled with said ink, wherein the ink tank is heated at the remperature required for this ink. However, these teachings are not straightforwardly suitable for thermoplastic ink.

It is the aim of the invention to remediate the disadvantages of this known technique, and to prescribe a process and a device ensuring with technically reliable means, an increased life of the printing plate and enabling a reliable use of thermoplastic inks.

In order to make this possible according to the invention, the holder or the ink tank, or both these components, are heated to the temperature required for the thermoplastic ink.

In a first possible embodiment, as an ink tank, an electrically heated ink tank is used, with circular or oval doctor blade of a hard material, such as hard metal or plastic material in the shape of a monolithic component of undeformable material, in which, at the periphery a circular or oval canal is made for attaching above said doctor blade by snap connection, as well as for attaching above said doctor blade to this component by glueing.

According to another possible embodiment, a device is used consisting of a combination of a heated ink tank and at least one doctor blade, of which at least the bottom edge which is contacting the printing plate, is adjusted with respect to the printing plate at a negative angle, measured with respect to the inked portion of the printing plate to be scraped off, and without changing the position of the doctor blade, a relative movement of the doctor blade with respect to the printing plate is generated, on the one hand, in a direction to ink the printing plate, and on the other hand, in the other direction, to scrape off the ink from the printing plate.

The invention also relates to closed ink tanks to be used within the frame of the invention.

Other details and advantages of the invention will show from the process for inking a printing plate attached to a holder, with thermoplastic ink and the ink tank used herein according to the invention. The reference numbers refer to the attached figures.

Figures 1 to 4 schematically illustrate a classical pad printing process.

Figure 5 schematically shows a closed ink tank with heated printing plate holder.

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Figure 6 schematically shows a closed ink tank with heated printing plate.

Figure 7 schematically shows a closed ink tank with heated holder.

Figure 8 schematically shows a closed ink tank with heated ink tank.

Figure 9 schematically shows a closed doctor blade chamber with heated printing plate holder.

Figure 10 schematically shows a closed doctor blade chamber with heated printing plate.

Figure 11 schematically shows a closed and heated doctor blade chamber.

The process shown by figures 1-4 schematically, but clearly illustrates the different steps of inking in the pad printing technique.

1 refers to the printing plate which is fixed in a holder 2, the deepened part of which forms the ink chamber 3, in which the ink is collected after the scraping off of the printing plate 1. In principle, a device for inking a printing plate always comprises an ink slab 4 and a doctor blade 5. These components are separately moved up and down by means which will not be described in detail here.

It is clear that the relative movements of the doctor blade holder with slab, with respect to the printing plate, are the result of both a movement of these components with respect to a stationary printing plate, and the reverse, and consequently that both the printing plate and the doctor blade with slab can be moved in opposite sense.

The techniques generally applied and briefly described show a series of disadvantages which can be summarized as follows:

a) The doctor blade is always adjusted in such a way with respect to the printing plate, that it forms a sharp angle with this plate, with the portion of the printing plate that has been inked and must yet be scraped off.
b) The printing plate is subjected to high wear, because of the pressure exerted by the doctor blade on the printing plate. A good scraping off of the

ink is indeed an absolute requirement, and this requires, at the installation of the doctor blade as described sub a), a high pressure of the doctor blade on the printing plate.

c) Each time, two movements are required, which can be summarized as follows: up or down movement of the doctor blade knife during the relative movements of the doctor blade with respect to the printing plate.

Since thermoplastic inks should be held at a constant controlled temperature, many disadvantages are connected to the process just described. These disadvantage are, i.a.

- severe wear of printing plate and doctor blade knife because of the required high pressure of the doctor blade knife on the printing plate, which strongly affects the print quality in a negative way.
- problems to keep the temperature at a constant level during the up and down movements of the doctor blade knife, which is continuously heated and cooled, as a result of which the doctor blade knife is rapidly "polluted" by hardened ink.

The combination of above disadvantages is the reason why a production with a constant print quality is almost impossibly feasible.

According to the invention now, because of the use of thermoplastic inks, a heated printing plate holder 4 or a closed, heated ink tank is used, but it will immediately be obvious that both these components could be heated.

The different embodiments of the process and the holders or ink tanks to be used herein, will be discussed hereafter.

In the embodiment according to figure 5, a printing plate 6 is used that is fixed into the printing plate holder 7. With 8, reference is made to an inking chamber with holder 9. So in this embodiment, only the printing plate holder 7 is heated.

Figure 6 concerns an alternative of the invention according to which the printing plate 6 is heated, whereas neither the printing plate holder 7, nor the inking chamber 8 are heated. As has been said before, a combination of the embodiments described just now, is conceivable.

In the embodiment according to figure 7, exclusively the inking chamber holder 9 is heated, whereas according to figure 8, only the inking chamber 8 is heated. In the spirit of the invention, the embodiments according to figures 5-8 can be both mutually combined.

The closed chambers 10 according to figures 9-11 relate to a very remarkable embodiment of the inking chamber to be used with this application. The closed inking chambers are combined here according to the embodiment described hereafter; i.e.

a) (Fig. 9) Here the inking chamber 10 is used in combination with a heated printing plate holder 7;
b) (Fig. 10) Here, exclusively the printing plate 6 is heated;
c) (Fig. 11) In this embodiment, exclusively the inking chamber 10 is heated.

In the spirit of the invention, the embodiments according to figures 9-11 may be mutually combined.

The inking chamber 10 is a particularly attractive embodiment. It consists of a housing 11, which in combination with two doctor blades 12, forms a completely closed inking chamber 13.

The ink 14 present in the inking chamber is spread out on and scraped off from the printing plate, simultaneously by both the doctor blades 8.

Because of the particular angle at which the doctor blades 8 are adjusted with respect to the printing plate 6, an "inking gap" of the closed inking chamber is realised, which is particularly advantageous for the use of thermoplastic inks.

The implementation of a closed inking chamber of the type illustrated by figures 9, 10 and 11, creates ideal conditions for the use of thermoplastic inks.

The striking advantages of the process according to the invention and of the closed inking chambers used herein, may be summarized as follows:

a) Since there are no up- and downward movements of both the closed inking chamber and the doctor blade chamber mechanism, these cannot cool

down.

b) Due to the limited amount of used thermoplastic ink which will be used according to the process, maintaining a constant temperature is simpler.

c) Minimum wear of the printing plate, because the pressure of the doctor blade chamber or inkpot on the printing plate is low.

d) Printing plates and ink are easily exchangeable, with very short exchange times.

e) A very economical ink consumption, because the ink losses upon cleaning are very small.

f) Because of the limited amount of used thermoplastic ink, and the absence of an ink tank, the machine more rapidly arrives at operating temperature after switching on, when starting up at room temperature.